UTATION AT THE KNEE-JOINT BY DISARTICULATION;

23

WITH REMARKS ON

PUTATION OF THE LEG BY LATERAL FLAPS.

BY

THOMAS BRYANT, F.R.C.S.,
SENIOR SURGEON TO GUY'S HOSPITAL.

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THOMAS BRYANT, F.R.C.S.,
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Amputation by disarticulation at the knee-joint was first performed in England by Mr. S. Lane at St. Mary's Hospital in 1857 ('Lancet,' 1857, vol. ii). The operation was first prominently brought before British surgeons in an able paper by Mr. G. D. Pollock[1] and more recently by Mr. P. Pick, in an interesting communication read before the Medical Society of London.[2]

I have practised the operation since the year 1868. In America it has found able advocates in Dr. Stephen Smith, of New York,[3] Dr. Markoe, of New York,[4] Dr. John H. Brinton, of Philadelphia,[5] and Dr Staples.[6]

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[1] 'Med.-Chir. Trans.,' vol. liii, 1870.

[2] 'Med. Soc. Proceedings,' vol. vii, 1884.

[3] 'New York Journal of Medicine,' Sept., 1852, and 'American Journal of Medical Sciences,' January, 1870.

[4] 'New York Medical Journal,' January, 1856, and March, 1868.

[5] 'American Journal of Medical Sciences,' April, 1868.

Ib., January, 1872.

Yet, in spite of this advocacy, the operation is not frequently performed. By the majority of surgeons it is still regarded with suspicion.

It is difficult to estimate how far this dislike of the operation is due to a want of experience of its advantages and how far to the groundless dread of leaving articular cartilage upon the bone, under the mistaken impression that it will probably undergo degenerative changes, and so retard repair. I would also give, as an additional reason for the neglect of the operation, the personal liking which surgeons have recently shown for what I, for the sake of clearness, prefer to call the condyloid operation of Velpeau, or the supracondyloid amputation of Stokes.

It is clear that the operations of Velpeau and Stokes, are applicable to cases of disease or destruction of the knee-joint itself, whereas the operation of amputation by disarticulation at the knee-joint can only be performed when the disease, or injury, for which the amputation is practised is localised to the leg; when the condyles of the femur are unaffected or but slightly involved; and when there is a sufficiency of healthy soft parts below the knee, from which good flaps can be made. With these conditions present, the operation of amputation by disarticulation should, for reasons to be given presently, be performed.

I will now proceed to consider the value of the operation as shown from my own practice.

Table of Cases of Amputation at the Knee-joint by Disarticulation.
(Pathological Amputations.)

Date of operation.	No. of case.	Name of patient.	Age.	Disease or injury.	Nature of operation.	Result.	Remarks.
Sept. 15, 1868	1	Edward L—	44	Extensive necrosis of the tibia	A single long anterior flap; patella removed	Good	Excellent stump. Soft parts moveable over condyles. No sloughing of flap.
April 13, 1869	2	Mary A. B—	8	Sarcoma of the tibia	A single long anterior flap; patella removed	Good	Anterior flap sloughed, and exposed one condyle of femur, from which the cartilage exfoliated. The child died in three months from a return of the growth in the stump.
Jan. 16, 1870	3	Thomas S—	48	Osteo-arthritis of knee. Limb like a flail, and disorganised	A medium-length anterior flap, with a long posterior flap; patella left	Good	An excellent stump was obtained. No sloughing.
Jan. 14, 1870	4	Thomas N—	16	A useless stump after an amputation of the leg for injury	Long anterior flap and long posterior flap; patella left	Good	Immediate union of the wound. Good stump.
Aug. 9, 1871	5	Eliza L—	38	Elephantiasis of foot, with extensive ulceration exposing bone	Long anterior and posterior flaps; patella left	Good	Excellent stump. No sloughing. Cicatrix in hollow of condyles and well behind bone. In 1884 stump perfect.

Date of operation.	No. of case.	Name of patient.	Age.	Disease or injury.	Nature of operation.	Result.	Remarks.
Dec. 4, 1871	6	James S—	65	Cancer of stump of leg, which started in cicatrix of amputation performed years before	Long anterior and posterior flaps; patella left	Good	Excellent stump. Integument moved freely over condyles.
May 7, 1872	7	Samuel H—	50	Cancer of leg, with necrosis of tibia	Long anterior and posterior flaps; patella left	Good	There was slight sloughing of the anterior flap, but a good stump, which a year later was pronounced "excellent."
April 19, 1872	8	John T—	32	Epithelial cancer of leg and tibia, with necrosis	Long anterior and posterior flaps; patella removed	Died on 4th day	Died on 4th day from shock. Diseased kidneys.
July 28, 1874	9	Daniel B—	21	Disease of knee of 15 years' standing, with displacement backwards	Lateral flaps; patella left	Good	Rapid recovery. Excellent stump.
Mar. 29, 1874	10	Minnie H—	13	Old disease of knee	Lateral flaps	Good	No sloughing.
Nov. 7, 1873	11	Caroline A—	26	Acute necrosis of tibia, with disease of ankle- and knee-joints	Lateral flaps; patella left; surface of one condyle taken away where the cartilage was eroded	Good	Rapid recovery. Good stump.
June 23, 1874	12	George R—	9	Distortion and deformity from infantile paralysis of leg	Lateral flaps; patella left	Good	Good stump.
Sept. 13, 1872	13	Walter G—	20	Useless and ulcerated stump after amputation for injury 9 years before	Lateral flaps; patella left	Good	Wound sloughed and gaped a little and exposed inner condyle, from which the cartilage subsequently came away. A good stump ensued.

				eight years standing; the limb wasted and flexed	was fixed to femur; left	weeks. Excellent stump.
April 28, 1881	15	John G—	68	Epithelioma of the leg, with the tibia	Lateral flaps; patella left	Good	Some sloughing of stump, exposing bone, which necrosed. Good stump eventually.
Jan. 19, 1882	16	Miss —	13 wks.	Congenital malformation of leg; absent tibia	Lateral flaps; patella left	Good	Union in five days.
Feb. 28, 1882	17	George L—	30	Chronic ulcer and epithelioma involving tibia	Lateral flaps; patella left	Good	Rapid recovery.
June, 1883	18	Maria W—	30	Diseased and displaced knee, with paralysis of leg	Lateral flaps; tibia separated by saw from one condyle of femur; patella left	Good	Rapid recovery. Good stump.
Oct. 13, 1868	19	Harriett N—	47	Gangrene of leg from embolus of popliteal artery and endocarditis	Long anterior flap and short posterior flap; patella left	Stump healed	Died in fifth week from heart disease.

Traumatic Cases.

Mar. 12, 1872	1	Henry B—	21	Gangrene of leg following obstructed external iliac artery, the result of a fractured pelvis 26 days previously	Antero-posterior flaps; patella removed	Died on 11th day	Sloughing of flaps and pyæmia.
May 22, 1874	2	William M—	28	Gangrene of leg following ruptured femoral artery 17 days before	Lateral flaps; patella left	Good	Excellent stump.

Date of operation.	No. of case.	Name of patient.	Age.	Disease or injury.	Nature of operation.	Result.	Remarks.
Feb. 10, 1874	3	Henry T—	14	Compound fracture of leg	Primary amputation; lateral flaps; patella left	Good	Capital stump.
Feb. 10, 1874	4	William E—	18	Crushed foot and leg	Primary amputation; lateral flaps; patella left	Good	Small slough on posterior flap from pressure of splint. Excellent stump.
Aug. 22, 1875	5	Catherine A—	61	Compound comminuted fracture of leg	Secondary amputation; lateral flaps; patella left	Died on 11th day	Sank.
Jan. 26, 1876	6	James G—	44	Compound fracture of leg	Secondary amputation; lateral flaps; patella left	Good	Small slough the size of half a shilling on one flap.
April 8, 1879	7	James L—	68	Compound fracture of leg, &c.	Secondary amputation; lateral flaps; patella left	Sank on 8th day	—
Feb. 21, 1873	8	Thomas B—	60	Compound fracture of leg 15 days previously	Secondary amputation; lateral flaps; patella left	Good	Good stump after 16 weeks.
May 23, 1877	9	Phœbe C—	8	Crushed and lacerated leg, with much loss of blood before operation	Primary amputation; lateral flaps; patella left	Died in 3rd week	Sloughing of stump and pyæmia.
Dec. 5, 1882	10	Stephen G—	52	Compound fracture of leg	Secondary amputation; lateral flaps; patella left	Died on 17th day	Septicæmia.
Feb. 13, 1883	11	William D—	30	Compound fracture of leg 19 days previously	Secondary amputation; lateral flaps; patella left	Died on 33rd day	Stump healed all except one sinus. On the 33rd day there was secondary hæmorrhage from the femoral artery, and death.

Analysis of cases.—Thirty cases have been tabulated, and of these, nineteen were amputations performed for disease or for reasons of expediency, and eleven for injury. In the group of nineteen *amputations for disease,* one patient only died from the operation (Case 8), a man aged thirty-two, suffering with epithelial cancer involving the tibia. He sank on the fourth day from kidney disease. Of the eleven *traumatic* cases six died (Nos. 1, 5, 7, 9, 10, 11), and of these it is fair to say that the operation simply failed to save life, since it was performed in Case 1 for gangrene due to obstruction of the external iliac artery, the result of over-stretching of the vessel by a displaced fragment of a broken pelvis; in Case 9 as a primary amputation of a limb, crushed by the passage of a tramcar over it, in a child aged eight who had lost much blood before the operation; and in Cases 5, 8, and 10 as a secondary amputation for compound fracture of the leg in a woman aged sixty-one, and in men respectively fifty-two and sixty-eight years of age. Case 11 was remarkable, since death took place on the thirty-third day from secondary hæmorrhage, the result of an abscess in the extremity of the popliteal artery, which had been twisted at the time of operation. The patient was a man aged thirty, for whom a secondary amputation had been performed for compound fracture. The stump had healed, with the exception of one sinus, which evidently led down to the popliteal artery. I give an account of the preparation obtained after death from the pen of my friend, Mr. John Poland: "The stump presented on either side an almost level granulating surface, and on the posterior aspect another granulating surface running vertically upwards. At the upper end of this there was a sinus leading into a small abscess cavity in the position of the end of the popliteal artery. From this sinus a good-sized stream of water flowed when the common iliac was injected by means of a syringe. The walls of the abscess cavity were composed of soft shreddy slough, and there was an entire absence of granulation tissue. About the middle of this abscess the divided end of the popliteal artery lay, presenting a most interesting condition. Suppuration had taken place between its middle and inner coats, burrowing upwards in such a manner as to completely separate the two for a distance of an inch and a half, so that the internal coat lay like a cast in the middle of the tube, and looked not unlike a coagulum. The upper part of this inner coat was thin and papery, and the upper limit of its separation from the outer coats abrupt and well defined. The lower three fourths of an inch, shaggy, softened, and sloughing, lay loose in the cavity. Above this presented the opening into the interior of the tube-like inner coat, which for a distance of an eighth of an inch contained the remains of some broken-up adherent coagulum. It was from this orifice that the hæmorrhage had taken place into the suppurating cavity and sinus. Corresponding to the whole length of the suppuration between the coats, the outer coats were found to be thickened by inflammatory material to double their normal size, and this condition extended upwards for a quarter of an inch above the upper limit of separation of the coats. Above this all the arterial coats appeared to be healthy. Below, the outer coats were continuous with that lining the abscess cavity and ended indistinguishably in it.

"The femoral vein was plugged for a distance of five inches with firm adherent clot. The suppuration between the coats of the popliteal artery being directly continuous with the cavity below, was clearly due to an inflammatory affection extending from the latter to the coats of the vessel, setting up a diffused suppurative arteritis. This inflammatory process is of an exceedingly unhealthy character, as shown by the sloughy condition of the wound and twisted end of the artery.

"I believe that all cases of secondary hæmorrhage at the present day will be found to be directly traceable to this particular inflammatory condition of the wound implicating the arterial coats. That this is a so-called septic form of inflammation I am not inclined to believe, but rather that it may be dependent, to a very great extent, on some particular tendency of the patient."

Remarks.—Upon the whole, the operation, with respect to its dangers, must be regarded with favour. Of nineteen cases of amputation for disease, one only, or about 5 per cent., died; and of the traumatic cases about 50 per cent. were fatal, whilst the causes of death in these fatal cases were, in all the examples tabulated, due rather to general causes than to any condition which can be directly attributed to the operation itself.

On sloughing of the flaps.—With respect to this question, as determined by the cases tabulated, sloughing took place in four of the nineteen cases of amputations for disease.

In Case 2 the slough was enough to expose a portion of one condyle of the femur from which the cartilage exfoliated.

In Case 7, that of a man aged fifty, who had epithelioma of the leg involving the tibia, amputation was performed with an anterior flap of median length and a posterior flap. A small slough on the anterior flap took place, but with no detriment to the patient.

In Case 13, amputation was performed in a man aged seventy, for a useless and ulcerated stump of the leg after an operation done nine years previously for some injury. Lateral flaps, after Stephen Smith's method, were adopted. Some sloughing of one flap took place, and exposed the inner condyle from which the cartilage exfoliated; but a good stump was subsequently secured.

In Case 15, that of a man aged sixty-two, with epithelioma of the skin and tibia, lateral flaps were also made. One of these sloughed and exposed the corresponding condyle of the femur, which underwent superficial necrosis. But in this case, as in the preceding, a good stump was secured.

Sloughing also followed in two of the five successful amputations for injury; but in both it was very limited, and proved in no way detrimental to the usefulness of the stump. In one of these—Case 4—a primary amputation was undertaken in a boy aged fifteen, for crushed foot and leg; lateral flaps were made, and a small slough formed in the posterior angle of one of the flaps from the pressure of a splint.

In Case 6, one of secondary amputation for compound fracture in a woman aged forty-four, a slough, the size of half a shilling, took place in one of the flaps, but a good stump resulted.

It occurred also in two of the fatal cases, but was in no way to be attributed to the operation (Cases 1 and 9).

Regarding the sloughing process with respect to the nature of the operation performed, it may be stated that of three cases in which the long anterior flap was employed (two for disease and one for injury), there was sloughing to a degree in two. In one of these, however (Case 1 in the table) gangrene had already resulted from plugging of the external iliac artery.

In six of the cases (all pathological) an anterior flap was made of medium length—about three inches and a half—extending from the posterior margin of the condyles downwards to a point an inch below the tubercle of the tibia. This was combined with a posterior flap of about two inches reaching down to the level of the tubercle of the tibia. In these six cases there was sloughing in one only (Case 7), in which, however, the process was very limited.

In the remaining twenty-one cases the operation was performed with lateral flaps, after the method of Stephen Smith. Eleven of these were amputations for disease. In two (Cases 13 and 15) sloughing occurred; whilst ten were traumatic cases, in three of which (Cases 4, 6, and 9) there was sloughing, but in the last case (9) the sloughing process was unconnected with the form of amputation.

Out of the whole thirty cases sloughing to a degree took place in eight. But if we eliminate Cases 1 and 9 in the traumatic table, in which the sloughing process had no relation to the operation itself, the number is reduced to six, or to one in every five cases.

In none of the successful cases did sloughing take place to any extent, and it never materially interfered with the subsequent value of the stump.

In the cases in which there was no sloughing an excellent stump was obtained. No trouble was ever experienced from the articular cartilage over the condyles of the femur during the healing process, and when the stump had healed, the soft parts moved freely and loosely over the end of the bone. The cicatrix in all the cases was placed well behind the femur (*vide* Fig. 3, p. 15).

In all but the first three operations the patella was preserved; the removal of this bone I found to be quite unnecessary.

Patients after this operation are usually able to bear any amount of pressure upon the stump, and they can walk with greater facility than can patients after any form of amputation through the thigh. This result is probably due to the fact that the attachments of the muscles of the thigh, and particularly of the adductors, are less interfered with than they are in supracondyloid amputations.

For my own part, I know of no great operation which is followed by less shock, which repairs so rapidly and with so little constitutional disturbance, which forms a better and more useful stump, and which enables a patient to walk so well with an artificial leg.

THE OPERATION.—Three different methods have been advocated,—the long anterior flap of Pollock, the lateral hooded flaps of Stephen Smith, and the lateral flaps of Pick.

The first operation, as described by Pollock,[1] is as follows: "I make it a rule to feel for the interval between the edges of the condyle and head of the tibia, and to commence my incision at that point, and immediately behind the edge of the hamstring muscle, as it crosses that space. I take especial care never to commence my incision higher than the margin of the condyle. The incision should be carried perpendicularly downwards on the side of the leg till nearly five inches below the lower edge of the patella, then gradually brought across the front of the leg, and when crossing the tibia should be quite five inches below the patella; then carried up the inner side to a point corresponding exactly to that from which the incision commenced. If the knife is introduced higher up than at the point mentioned, the incision will not only be longer than requisite, but the blood-vessels on each side, which pass from behind forwards, are unnecessarily divided at the base of the flap, and consequently its arterial supply is diminished by so much, and sloughing or ulceration of some portion of its extremity rendered more probable. I usually make the posterior flap by cutting from without inwards; it should not be too short, and should consist merely of integument. As soon as the flaps are completed all the structures round the joint should be divided at a right angle with the limb."

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[1] 'Med.-Chir. Trans.,' vol. liii, 1870.

Pick's operation is described as follows:[1] "An incision was commenced at the upper border of the patella, and carried down the middle line of the limb as low as the tubercle of the tibia; it was then curved outwards over the outer side of the leg to the back, and carried upwards along the middle line to a point corresponding to the commencement of the incision on the front of the leg. A similar incision was carried round the inner side of the leg, and thus two somewhat quadrilateral flaps with rounded corners consisting only of skin and subcutaneous tissue were mapped out. The lowest point of these flaps was about an inch and a half below the level of the tubercle of the tibia. They were dissected up as high as the articulation, the patella was removed, and the various structures around the joint divided by a circular sweep of the knife." Pick claims for his operation the following advantages: that better drainage is secured than by that of the long anterior flap; that the flaps are less liable to slough; and that the cicatrix is placed in the intercondyloid notch between the two prominent condyles of the femur, and is not therefore subjected to any direct pressure from the artificial limb. These claims, when compared with Pollock's long anterior flap are just.

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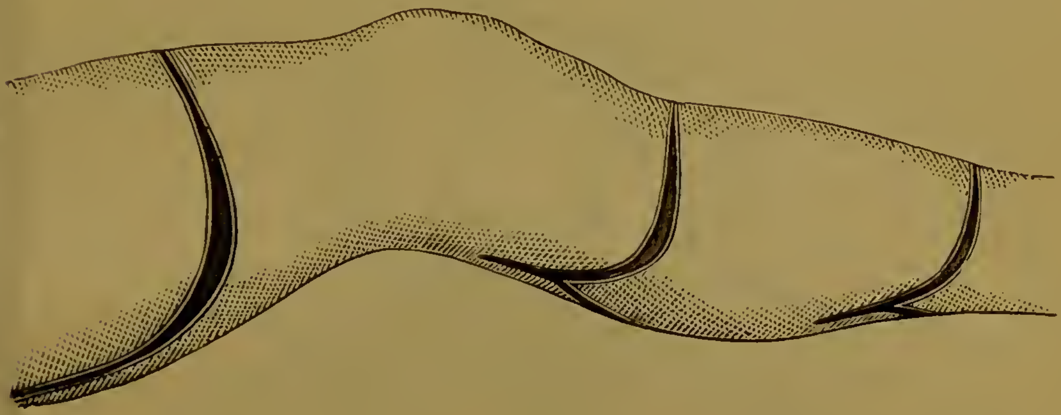
[1] 'Proceedings of Medical Society of London,' vol. vii, 1884, p. 134.

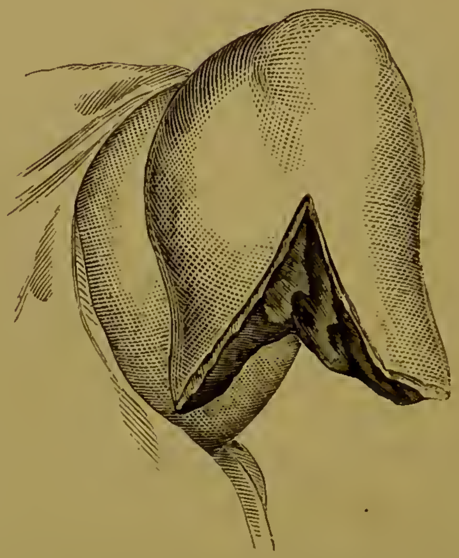
Mr. Stephen Smith's amputation is described as follows:—"The incision is commenced about an inch below the tubercle of the tibia (Fig. 1), and carried downward and forward over the most prominent part of the side of the leg, until it reaches the under surface, when it is curved towards the median line. When that point is reached, it is continued directly upward to the centre of the articulation. A second incision begins at the same point as the first, and pursues a similar direction upon the opposite side of the leg, and meets it in the median line in the posterior part. The line of incision upon one side is seen in Fig. 1. The following points," adds Stephen Smith, "should be remembered, viz. the incisions should incline moderately forwards down to the curve of the side of the leg, to secure ample covering for the condyles; and

FIG. 1.



that upon the internal aspect should have additional fulness for the purpose of ensuring sufficient flap for the internal condyle of the femur, which is longer and larger than the external. In the dissection the skin, fascia, and cellular tissue are raised and the ligamentum patellæ is divided, allowing the patella to remain. The appearance of the flaps immediately after disarticulation is seen in Fig. 2. It will be noticed that the extremity of the femur is already completely covered, and the line of union of the flaps will be between the condyles and over the intracondyloid notch. When cicatrisation is complete the cicatrix sinks into this notch and disappears from the face of the stump, and offers no point of contact with the artificial appliance. The appearance of the stump on recovery is given in Fig. 3. In the process of repair, it will be found

Fig. 2.

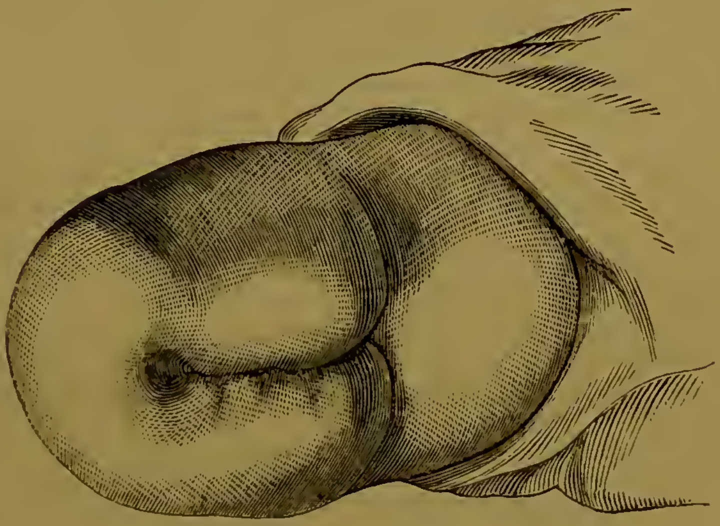


Appearance of flaps immediately after disarticulation.

that the drainage is so perfect that all the anterior portion of the wound remains dry and frequently heals by immediate union.

"This method of amputation need not be limited to the knee. The advantages of drainage, and the removal of the cicatrix from the face of the stump to its posterior part, equally adapt it to amputation in the leg or thigh. I have frequently amputated at both of these points by this method and obtained the most satisfactory results. The wound heals with remarkable rapidity, and the final perfection of the stump leaves all that can be desired. In Fig. 1 the line of incisions is given in amputation of the leg and thigh by this method. The incision on the posterior part of the leg should extend upwards to the point where the bone is to be sawn through, and there the muscles are divided circularly."[1]

FIG. 3.



Posterior view of stump.

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[1] 'American Journal of Medical Sciences,' January, 1870.

I have described this operation in Dr. Stephen Smith's own words, and illustrated it with copies of his original woodcuts, Figs. 1 and 2, in order to do his operation full justice, and that there should be no misunderstanding as to his method. I endorse all his remarks fully, and would urge the application of his method of operating at the knee to the leg as strongly as I can. Indeed, I may say that his operation upon the leg, with but slight modifications, has been practised at Guy's Hospital for more than forty years, although it is difficult to discover with whom it originated. My friend, colleague, and teacher, Mr. E. Cock, whose memory goes back to Sir A. Cooper, is unable to say when it was introduced, and I am rather disposed to think that the line of incision was Mr. Cock's. That excellent surgeon, however, has always included the muscles of the leg in his flaps, and, I am bound to add, with a good result. This practice of including muscle in the flaps has not, however, been adopted by all his colleagues or followers. In thin subjects it has been the rule, in others it has been the exception. The muscles are then divided by a circular cut. The stumps that result from this form of amputations in the leg, as in the knee, are perfect, and are certainly better than those obtained by the majority of other forms of amputation. In an examination at a certain university, where a candidate performed the operation, it was condemned, the examiners, having regarded it as a fancy measure, being unaware that it had been extensively practised at Guy's Hospital, and that it had also been for years before the profession in the pages of a student's text-book which has passed through many editions. I repeat here the two drawings which have illustrated the operation since 1872 (Figs. 4, 5). This ignorance of its value is to be regretted, and if these lines will help its progress towards more general adoption their author will be satisfied.

Of the three methods advocated for amputation at the knee, that of Stephen Smith is greatly to be preferred, since it provides a better covering for the condyles of the femur than is obtained by any other method, and the flaps are far less prone to slough than in the long five-inch anterior flaps advocated by Pollock. This view is

Fig. 4.

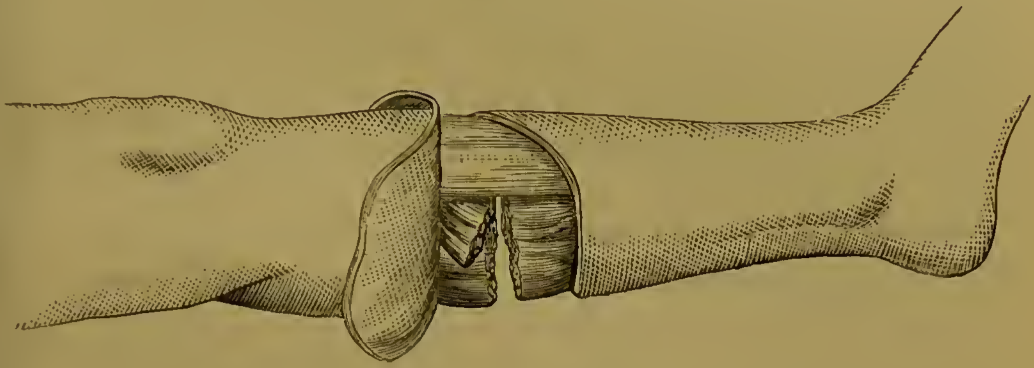
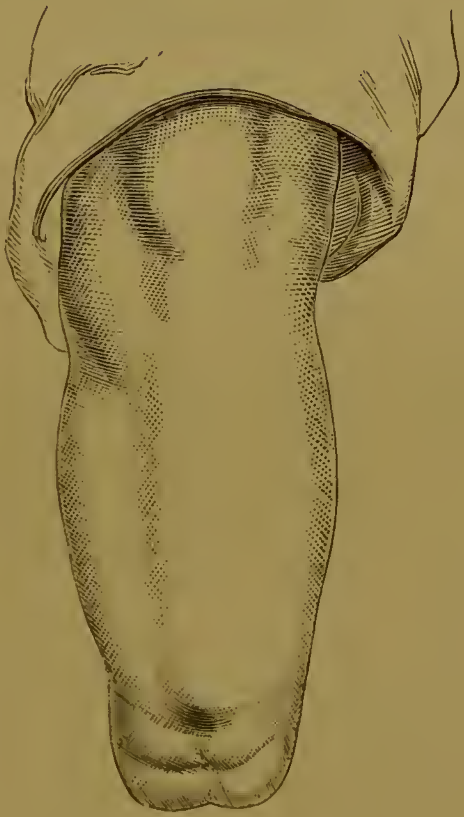


Fig. 5.



supported by the fact that of my own twenty-one cases, in only four, or in one out of every five cases, could it be said there was any sloughing, and in all of these the process was of a limited extent; whereas, out of Mr. Pollock's five cases in which this operation was performed there was sloughing in three; and out of twenty-nine other cases tabulated by Pick from the St. George's Hospital records, sloughing occurred in sixteen, or, taking the whole number of cases in which a long flap was made as thirty-four, sloughing followed in nineteen, that is, in 55 per cent., or more than half.

The method advocated is likewise to be preferred to Mr. Pick's operation, from the fact that in the former the incision is commenced one inch below the patella, and, as a consequence, the cicatrix is eventually placed entirely behind the condyles and out of harm's way; whereas, in Pick's operation the incision starts from a point above the patella and the cicatrix lies in the intercondyloid notch.

With Stephen Smith's flaps, moreover, there is no place for bagging of fluids after the operation; for, with the patient on his back, and with the femur horizontal, the edges of the flaps when brought together present downwards towards the plane of the body, and consequently the stump is in the best position for drainage. The flaps at the same time form a complete hood to the condyles.

In performing this operation I have, on four occasions, after completing the skin flaps, and—with the knee flexed upon the femur—making an incision along the anterior border of the head of the tibia, so as to divide the coronary ligaments, and expose the joint, found the semilunar cartilages closely encircling the condyles of the femur. So tightly did they do so that on the two occasions on which I removed them they had to be dissected from their position. In the two other cases they were left *in situ*, to the great advantage of the patients. Indeed, I would suggest that this latter practice should be the one followed where it can be, for by this means the upper part of the synovial capsule is held down firmly to the condyles of the femur, and thus all the soft parts are kept well in place.

Since writing the above I find Dr. Brinton, so early as 1872, advocated this practice[1] in the following words: "I divide the coronary ligaments so as to allow the semilunar cartilages to remain upon the articular end of the femur and in the stump. By thus leaving them in position I have a cap fitted upon the end of the femur, which preserves all the fascial relations, eventually prevents retraction and guards against the projection of the condyles. I insist somewhat strongly upon this retention of the semilunar cartilages, since I regard it as having an important bearing upon the future wellbeing of the stump."

It is more than probable that this displacement of the interarticular fibro-cartilages may take place under other circumstances as by some accidental rupturing of the coronary ligaments, and if so, some of the cases of injury to the knee now registered under the title of internal derangement may be explained.

There is but little bleeding in this operation, and, with the exception of the popliteal and two superior articular arteries, there are none to twist. The popliteal vein had better be tied by a carbolised gut ligature. The condyloid origins of the gastrocnemius muscle had better be removed.

By way of conclusion, the advantages of this form of operation over amputation through the thigh may be stated as follows:—

1. The lessened shock of operation.
2. The lessened section of tissues and the non-exposure of the muscular interspaces of the thigh.
3. The escape from the necessity of sawing the femur, with its attendant risks.
4. The preservation of the attachments of the thigh muscles, and consequently the greater mobility of the stump.

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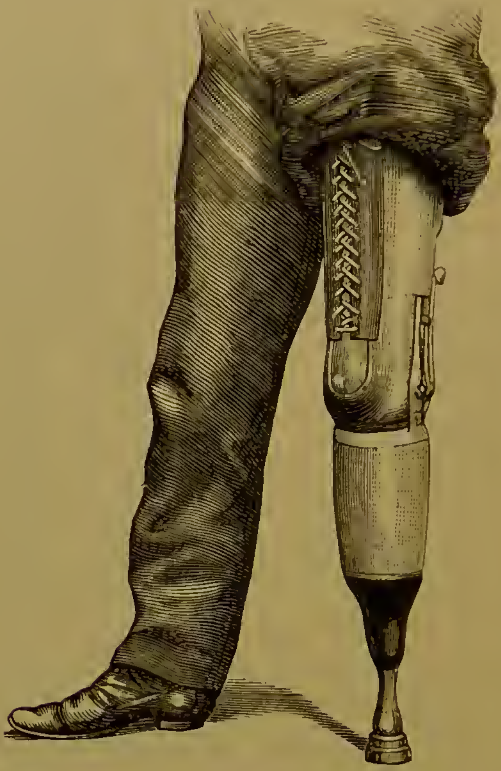
[1] ‘Philadelphia Medical Times, December 28th, 1872.

5. And last but not least, the useful character of the resulting stump.

FIG. 6.



Artificial limb adapted to stump after operation.

(For report of the discussion on this paper, see 'Proceedings of the Royal Medical and Chirurgical Society,' New Series, vol. ii, p. 27.)